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ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This teaching guide, designed to be read in conjunction with the related student guide, includes instructional strategies, lists of required materials, laboratory procedures, and other information for activities and experiments which focus on the characteristics and classification of living things. The study of these differences is used to introduce students to the need for classification. Simple classification exercises based on observed characteristics and activities which examine larger animal groups are included. Other activities include measuring living things, examining normal and random distributions of characteristics, making a collecting net, seeing if plants move, and planting trees. Each section in this guide corresponds to a given section in the student study guide. (JN)

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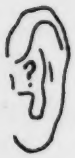
April 1981

TEACHER'S GUIDE

In the guide to each lesson, symbols will be used to indicate t he point at which teacher activity might be needed. The symbols are as follows :-

Practical work. The necessary instructions for each experiment will be given to you when you see this symbol.

Written exercises for the pupils. If possible these should be put on the blackboard before practical work begins so that the pupils can see what to look for.



Teacher information. The pupils will need extra guidance at these points. The information they will need from you is given where you see this symbol.

These will appear at the same point in the study guide.

Take note of an important point.

This symbol indicates a preparation of apparatus which should be done well ahead of time. Please read these notes carefully and carry out the instructions well in advance.

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AIMS OF THIS UNIT

At the end of this unit the pupils should be able to :-

1) Identify important differences between similar organisms.
2) Explain the differences between a normal and a random distribution of characteristics.
3) List 2 characteristics which show normal and 2 which show random distribution.
4) Classify a set of objects or organisms on the basis of characteristics.
5) Identify an organism by using a simple key.
6) List a large variety of living things.
7) List some differences between living and non-living things, plants and animals, flowering and non-flowering plants and the 5 groups of Vertebrates.
8) Be able to use magnifying instruments.
9) Use some variables in an animal experiment.
10) Plant a gum tree.

Teacher's Guide

Unit A2 - Looking at Life

Welcome to Unit A2 of the Zim-Sci course. This unit is a Biology unit and we hope your class will enjoy the new experiences presented here.

General hints about the course are contained in the TEACHER'S HANDBOOK. Please continue to refer to this handbook as it should prove useful. Each teacher's guide is designed to be read together with the appropriate pupil study guide.

This unit is designed to introduce the pupils to the study of living things.

A characteristic of life is the number of differences which exist. The pupils investigate some of these differences, both in appearance and behaviour, and are introduced thus to the need for classification.

They will attempt some simple classification based on observed characteristics and learn some of the larger plant and animal groupings.

SPECIAL NOTE

Biology experiments usually take longer to happen than those in Physics and Chemistry. Here are some you must start now so that you can observe them over the next few weeks.

Look through the unit for the pages with the (P) sign

Read the instructions now so that you can start your lesson preparation in good time. e.g. The demonstration to be given on page 43 of the pupils guide can be done at any of these points in the pupils guide

a) The beginning of part 2 page 12

b) After the field expedition (page 19)

c) Or at page 43, depending on how fast the beans grow.

You will also need to make a straw infusion, collect material and so on.

Do not try to rush the class, but encourage them to handle live material. They should find that Biology is fun and that there is more to nature than meets the eye!

There will be a lot of work for you in this unit, but we hope you will find it worthwhile.

THE COLLECTION

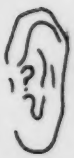
The pupils have been asked to start a school collection. This collection is a vital part of the materials required to teach Unit A2.
Shells, zongogoro rings, bones and fish scales add interest to the lesson on vertebrates (pupils guide page 22) so give a lot of praise to pupils who bring any to school.

Keep a lookout yourself now for specimens, because when the weather gets cold there will not be as many to find. Collect a few extra forked sticks and paper for pressing.

Set aside a baby bath or old cardboard box in a corner of the class labelled "The Collection" in which to deposit specimens.

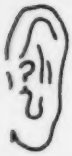
Demonstrate to pupils how to press soft plants thus :

1. Spread paper on a flat surface
2. Arrange plant neatly
3. Cover with more paper
4. Place a flat weight, e.g. stone or book on top
5. Leave for 2 weeks
6. Several plants can be pressed in layers on top of each other



Give the pupils each a plastic bag to put their specimens in

Please read page 3 to the pupils, so that they know what to find.



Page 4 Pulse rates

This exercise can be done in the same way as you did the histogram on wall length guesses in Unit A1. Collect the pulse rates from the pupils (They can look them up in Experiment 17, Question 2 in Unit A1.)

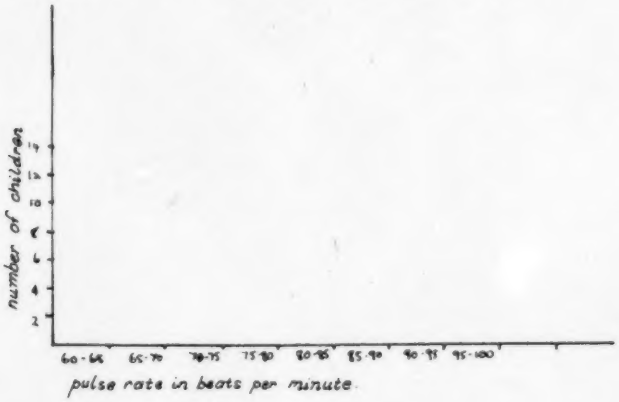
Find the lowest pulse rate. Group the pulse rates in 5 beats/minute or other suitable divisions according to the range. For example, suppose the lowest beat is 63 beats/min. Make the first group from 60 - 65, the next from 65 - 70 beats/min. and so on.

They can copy down as follows:

Pulse Rates

My pulse rate is .....

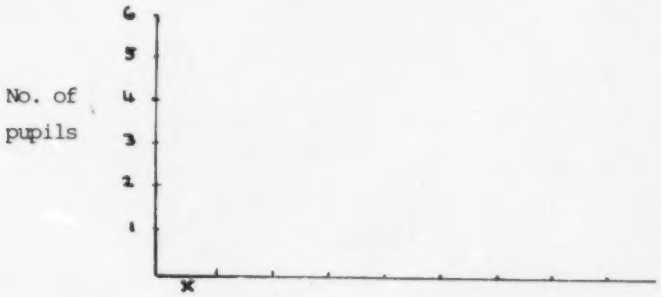
A histogram showing the pulse rate in the class



The most usual pulse rate in my class is .....

Page 4 Experiment 1 Finding the heights of pupils in your class.

Draw the sides of the histogram (axes) on the board like this.

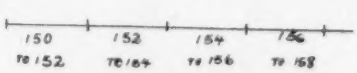


Heights in 2 cm divisions

Line up the pupils in order of height and find the shortest child. Stand this pupil against the wall. Put a ruler on top of his/her head and make a (chalk) mark on the wall at this height. Measure the distance of this mark from the floor. This would be the height of the shortest pupil.

Record this measurement (eg 150cms) at the point X on the horizontal axis. Number the rest of the axis in divisions of 2 cms

e.g.



Now put the same measurement (e.g. 150 cms) on the line marked X in the diagram

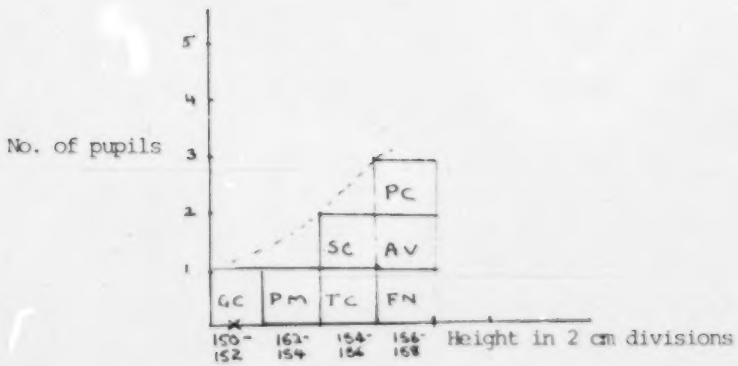
You will see that the margin above this line is marked in 2 cm divisions.

Hold this up against the wall with the line marked X next to your chalk mark. You will then be able to measure the rest of the pupils quickly.

For instance if the 2nd pupil is 150 cms + 2 cms, he is 152 cms tall.

An interesting way to make this histogram is to let each child go up to the board, just after being measured and draw a block in the relevant place putting his/her own initial in the block.

Hold up this diagram to be able to measure heights quickly.



How the histogram should look
as it is being made by the pupils.

Hopefully you will be able to draw a rough normal distribution curve by joining up the tops of the blocks built up by the pupils after they have all been measured.

The pupils must write their own height in their note books and copy down the histogram. They should not waste time drawing in each block and initial.

Exercise 1

My height is .....cms

A histogram of the heights of the pupils in the class.

The most usual height in my class is .....

P

Page 5 Experiment 2 Measuring leaves on a plant

Provide small plants i.e.weeds or small branches from trees, each having about 40 - 50 leaves.

Try to provide 1 small plant per pair of pupils. Otherwise group pupils according to the number of plant samples you have managed to bring.

The pupils should be able to read up and do the experiment themselves.

Explain that when making piles the leaves should be placed one on top of the other.

They can write up Experiment 2 themselves as described in their Pupil's Guide, Exercise 2.

They should obtain a normal pattern if they have grouped the leaves correctly.

Page 6 Experiment 3 Shoe Sizes

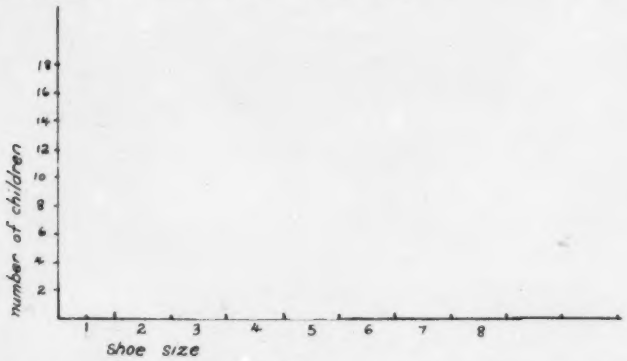
The pupils will measure their feet and you can collect shoe sizes, putting one block per pupil on the board in the relevant place as you did for their heights.

They can copy the histogram and write down the exercise as follows :

Exercise 3

My shoe size is .....

A histogram of shoe sizes of the class



The most common shoe size is .....

The next series of experiments are to show a random kind of variation. Characteristics with a random variation do not show a normal distribution.

Experiment 4 More measurements of themselves

The pupils can decide themselves whether they are right or left handed. Ask for all those who are right handed to put up their hands. Count them. Write the number on the board. Ask for all those who are left handed to raise their hands. Count them and put the number on the board.
Count the number in the class.

The pupils can now be given Exercise 4, Question 1.

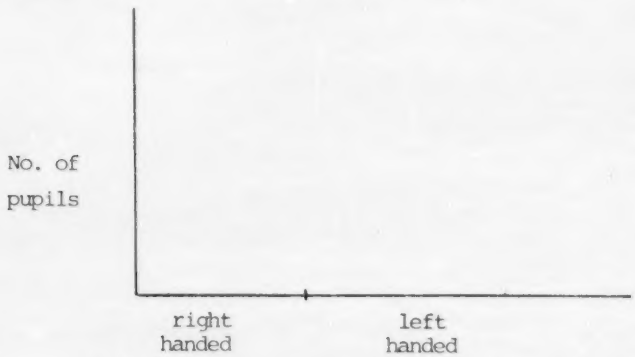
The pupils can work out the percentage.

Carry out the Experiments 4 (2) and 4 (3) on earlobes and tongue rolling in exactly the same way.

Exercise 4

1. I am .....handed.
   There are .....pupils in the class altogether.
   There are .....pupils in the class who are right handed.
   There are .....pupils in the class who are left handed.

I can make a histogram of these results :



Therefore the percentage of right handed pupils in this class is .....

and the percentage of the left handed pupils in this class is .....

.....handedness is more common than .....handedness.

2. I have/have not an earlobe.

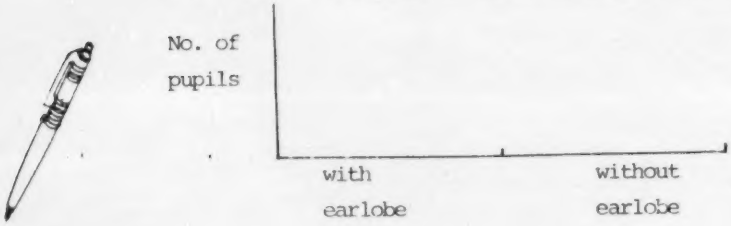
My partner ..... an earlobe.

There are .....pupils in the class altogether.

There are .....pupils in the class with earlobes.

There are .....pupils in the class without earlobes.

I can make a histogram of these results as follows :-



The percentage of pupils without earlobes is .....

The percentage of pupils with earlobes is .....

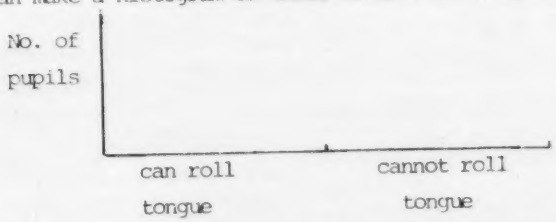
It is more common to have/not to have an earlobe.

3. I ..... roll my tongue.

There are .....pupils in the class altogether.

There are .....pupils who can roll their tongues.

I can make a histogram of these results as follows :-



Therefore the percentage of people who cannot roll their tongue is .....

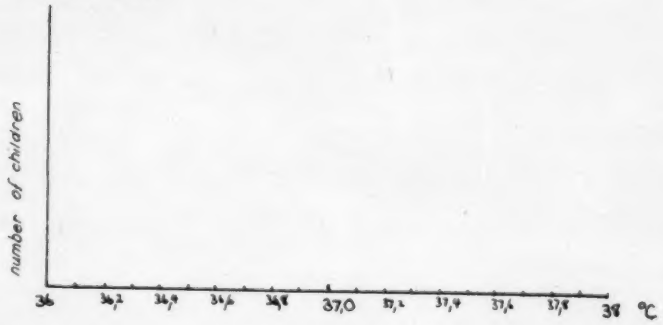
And the percentage of pupils who can roll their tongue is .....

It is more common to be able/ not to be able to roll one's tongue.

Page 11 Experiment 5 The Clinical Thermometer

There should be 4 clinical thermometers in the cupboard.
Therefore divide the class into four groups.
Give each group a thermometer, a piece of cotton wool and some methylated spirits in a small beaker.
Show them how to shake the mercury down. Tell them to dip the thermometer in the methylated spirits, then wipe it off on the cotton wool before each temperature is taken.
Show them how to put the bulb under the tongue and not close their teeth on it or they may bite the end off accidently!
The should keep it in their mouth for about one minute.
Collect the temperatures in groups and make a histogram on the board. The readings will probably lie between 36 - 38°C so the horizontal axis can be marked with divisions of $\frac{1}{10}$ of a degree.

Are differences in temperature distributed in your class in a random way or can you draw a normal curve over the bars?



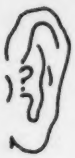
Give them Exercise 5 as follows :

Exercise 5

My temperature is .....
The most common temperature of pupils in our class is .....
The histogram shows a normal/random pattern.

PART 2

Page 12 A puzzle picture Diagram 4



Living/non living characteristics.

The picture puzzle should suggest to the pupils 4 different characteristics to distinguish between non-living and living things.

The seeds in the pod and chicken hatching suggest birth and reproduction. The creeper twining and growing upwards, the man running suggest movement. The dead maize plants and buck suggest death. The rain on the plant and hen eating suggest need for food and water.

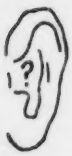
A class discussion for further points may bring in suggestions such as sensitivity/reaction/feeling or growth. Only include those marked * on the chart if mentioned by the class.

The chart may be filled in as follows :-

Characteristics of living things	Characteristics of non-living things
They are born	They are not born
They will die	They will not die
They can reproduce (that is they can make more like themselves)	They cannot make more like themselves
They can move	They cannot move themselves
They need food and water	They do not use water or food
* They grow or change	They do not grow or change
* They can feel	They cannot feel

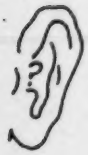
If the students do not think that the answers to 'b', 'c' and 'd' are that they <u>are</u> living things, try to give them some clues. For example "does a mealie pip grow, make more, will it die ?" etc.

Page 14 Diagram 5



This lesson should promote some lively counting and naming. Choose children in turn making a game of thinking up names of living things. Point out that flowers, trees and mushrooms are living things too. Local names of plants and animals may be used and language does not matter here.

Write up all the suggestions on the board. Count up all the names afterwards.



Page 16 Experiment 6 Alike and not alike

Allow the pupils time to puzzle over the characteristics and subsequent grouping and they should actually put the apparatus into 2 groups, and then 4 groups etc. When they have done this they can write down the list of characteristics they have chosen.

You can then demonstrate "a possible way" or "the way you choose to do it" in front of them. Do not make them feel that your way is the only correct way! Here is a suitable"possible way."

Separate the plastic from the non plastic things, putting funnel, spatula, beaker, 2 and 5 ml measures on one side, saying "These are made of plastic". Push the rest on one side saying "And those are not made of plastic". So the characteristics chosen for the first set is "Things made of plastic or not made of plastic", i.e. the material they are made of.

Then separate the beaker, 2 and 5 ml measures from the spatula and funnel saying "These are shaped like a cylinder and these are not". So the characteristic chosen for the second set is "shape".

Separate the measures from the beaker saying "These have handles and this does not", so the characteristic of the third set is again shape.

Separate the 2 measures saying "This one is bigger than the other. This says 5 ml and this says 2 ml.", so the characteristic chosen for this set is "size".

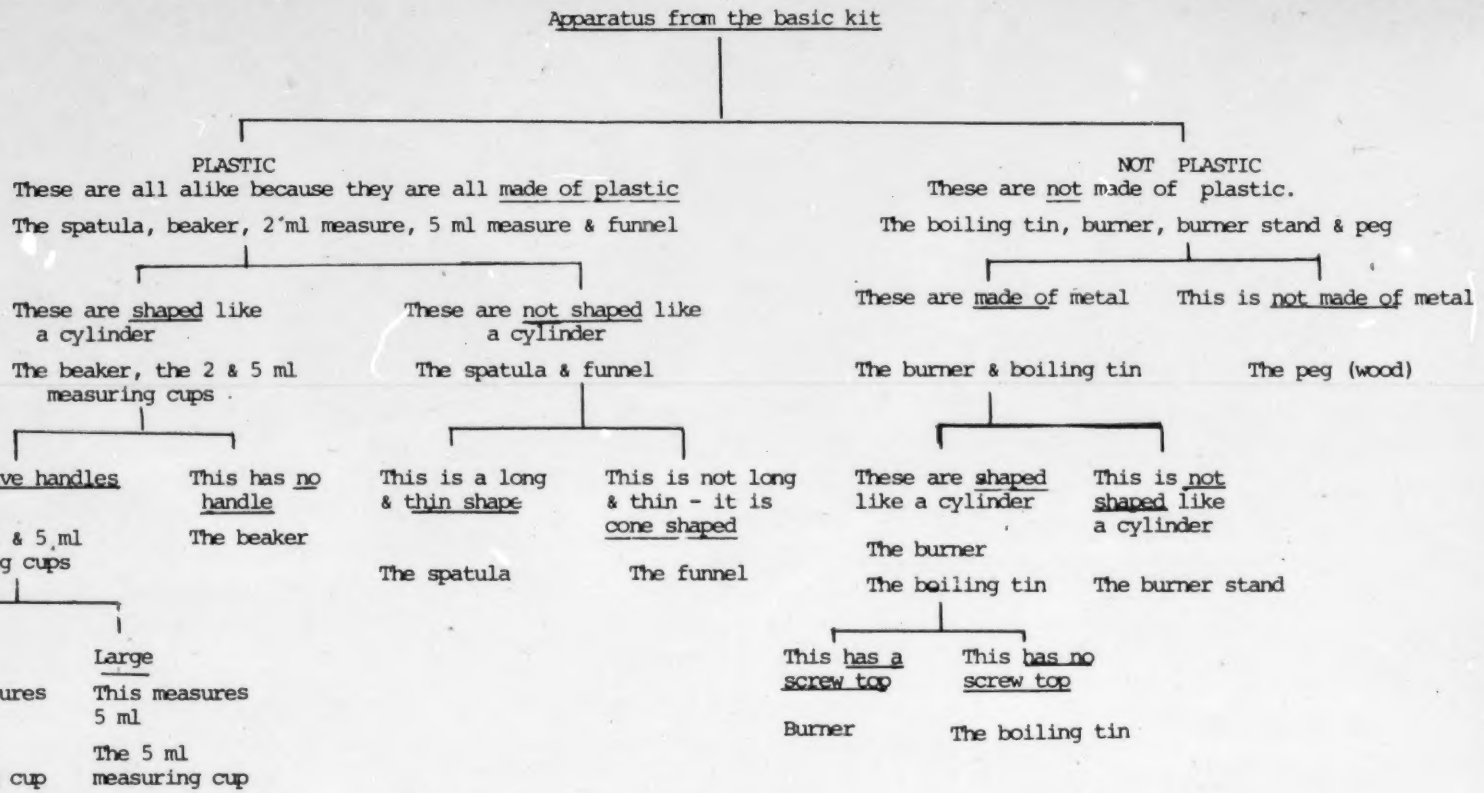
Separate the other group this way :

Tin, burner, burner stand on one side and the peg on the other saying "These are made of metal and this is not", so the characteristics of this set are again material it is made of and so on.

You ean remark at this point that the list of characteristics quickly becomes muddling (they will probably have noticed this themselves). Tell them that there is a neater and more logical way of doing it and that is by making a key.

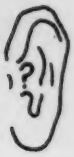
please turn over

The chart which you should put on the board for the pupils to look at


Apparatus from the basic kit
PLASTIC
These are all alike because they are all made of plastic
The spatula, beaker, 2 ml measure, 5 ml measure & funnel
These are shaped like a cylinder
These are not shaped like a cylinder
The beaker, the 2 & 5 ml measuring cups
The spatula & funnel
These have handles
This has no handle
The 2 ml & 5 ml measuring cups
The beaker
This is a long & thin shape
This is not long & thin - it is cone shaped
The spatula
The funnel
Small
Large
This measures 2 ml
This measures 5 ml
The 2 ml measuring cup
The 5 ml measuring cup
NOT PLASTIC
These are not made of plastic.
The boiling tin, burner, burner stand & peg
These are made of metal
This is not made of metal
The burner & boiling tin
The peg (wood)
These are shaped like a cylinder
This is not shaped like a cylinder
The burner
The boiling tin
The burner stand
This has a screw top
This has no screw top
Burner
The boiling tin

Now tell the pupils

"You can see now that if you have never come across the burner stand before, you could pick it out of the kit box if you were told it was "a piece of apparatus made of bent mental and not cylinder shaped :"

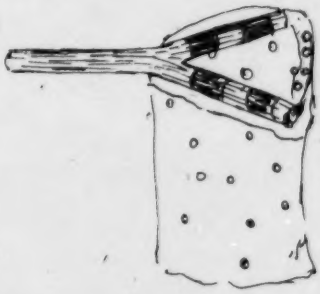


Page 17 Show the pupils how to make a net

You will need: a spatula
a plastic bag
some thread
a forked stick (collected earlier as instructed)
a straight stick (see below)

Find a forked stick about the size of the one in the diagram.

Take a plastic bag. Poke holes in it with the stirring end of your spatula, making small holes all over. Make 12 bigger holes in a line 2 cms from the top as shown.



Push each end of the forked stick in and out of 4 holes as shown. There should be 4 holes left.

Take a straight stick about 15 cms long. Push this in and out through the last 4 holes. Tie the ends of this stick to the ends of the forked stick with thread.

This is a net for catching animals such as grasshoppers or tadpoles.

Give out plastic bags to the pupils and tell them to make nets for themselves to use on the expedition.

Page 18 The Field Expedition

P

This lesson is what YOU may make of it.
Some days before look around and try to find a place near the school which has some variety - a rocky outcrop, anthill, stream (warn pupils not to touch the water because of bilharzia), a vlei, a hill or even up a tree. You can take the class to several places in turn or divide the class into groups each studying a different ecology depending on how far apart the diffierent features are. If the surroundings to the school are dull and do not appear to be a fruitful source of specimens you could try to arrange a class visit elsewhere.

Any extra material - animals or plants - fungi or lichens or trees which you collect would make the lesson after the expedition more interesting.

For the class visit the pupils should have their catching nets already made.

Small animals should be in plastic bags which have fresh plant material included as a food supply and pin holes in them for air exchange. You should give them each a plastic bag and a pin for poking holes in the bag.

Dry materials, plants and packets of animals should be accompanied by notes on where the material was found, and any other relevant points of interest.

The class must have the plastic bath to put all the specimens in.

They have a list of requirements in their study guide.

N. B.

Put up the poster on trees and indicate the different shapes of leaves and pods on it. This should encourage the pupils to look out for interesting plant material.

You might like to read these instructions to your pupils before you go on the expedition.

"You are going to find and look at as many different living things as possible. These are called specimens. In your notebook you must record, describe and if possible, draw or name all the living things you see, but cannot bring back to the classroom. Those may be large animals, birds or dangerous animals such as snakes, scorpions and wasps. Look in all sorts of places - peel the bark off trees - you may find ants or woodlice.
(If you are lucky enough to go to a stream or dam do not touch the water! Use your net!) Be careful when you lift stones to look under them in case of snakes or scorpions. I will be with you when you want to do this.

The picture shows you how to use your net and cup to catch insects. You can then put them into a plastic bag. When you do this put some fresh leaves in the bag too for the insect to eat. The pin holes in the bag will allow air in so that the animal can breathe. You may be able to put several insects in the bag, then knot it up and put it in the plastic bath. Keep the bath in the shade.

Look for different shapes of leaves, seed pods, flowers and grass heads. Pick a piece of each and put into the plastic bath. When you get back to the classroom the soft leaves and flowers or grasses can be pressed. If you do not press them they shrivel in a messy way. Pressed flowers lose their colour. This is why it is important to make notes when you collect specimens.

Special things to look for

A mushroom and the crumpled grey/green growth on rocks or tree bark. I might point this out to you! These are examples of non-flowering plants.

Whenever youcollect something, make a note of it in your book. Put down things like where you found it - if there were many of the same kind.

BE A SCIENTIST BY OBSERVING, NOTICING AND RECORDING !"

The Field Trip

If your lessons are running behind schedule OR if there are no good places to find near the school, you can use 1 lesson of a double period to do the collecting of specimens, counting, grouping and describing with the class. However, the pupils enjoy getting out of the classroom, and if time permits and there is a good source of specimens, a double period in the field should be attempted.

If the field expedition takes a full double lesson, the specimens will have to be kept in good condition until the next lesson. Pupils should therefore :

1) Press soft plants
2) Check the comfort of the animals and leave them in the plastic bath in a cool place or in the large bottle/locust cage

Larger animals (if any) i.e. frogs or lizards should be kept in the asbestos animal cage, not in plastic bags.

3) Put all dry pods, lichens etc. in a box.

The follow up on the field expedition

1) Count the number of specimens.
2) There is a written assignment in which each pupil describes : a plant and animal, and makes a rough labelled diagram. (Exercises 7 & 8)
3) Pick out several pairs of pupils who have described similar specimens. For instance 2 descriptions of beetles, or 2 descriptions of grasses. Each pupil could read his out showing diagram and specimen and then the class could be asked to find the differences.

The class should be asked to find first the similarities i.e. both are large plain leaves, and then the differences, i.e. one is hairy and the other is smooth.

4) The specimens can be laid out on a table and the class asked to arrange them into several groups according to their characteristics.

Some characteristics you could suggest they look for if they seem puzzled by the whole exercise are :-

Plants could be grouped -

1) flowers 2) seeds 3) differently shaped leaves
4) grass heads.

They may decide to match up colours or sizes - this is acceptable as long as you can see similarities within the group which they make.

Animals could be grouped

1) without legs, 2) with legs 3) number of legs
4) whether the specimen is soft or hard
5) whether it has wings
6) whether it has eyes or feelers
7) its colour, etc.

N. B. Please note that the heading for page 19 is "Exercise 8".

Release all live animals directly after this lesson.

Page 20 Flowering and Non-Flowering Plants

P If you can bring in some flower or grass heads, this would be a good idea. If you live in a damp area, some moss or fern - a mushroom or pine cone, some green algae from water - all would be wonderful to show the pupils. If you haven't any this year, be on the look out for some next year.

Page 20 A non-flowering plant to show the class

P About a week before doing this lesson prepare a mould for the class to look at. This is an example of a plant which is not green.

You will need : 1 piece of bread - any old crust will do
1 plastic bag

Wet the bread, place the bag and seal it (tie up the ends). In 3 - 4 days patches of grey, red, green or black will start appearing, pass around the class in plastic bags.

Explain to the pupils that the diagram of the mould (magnified) at the bottom of page 21 (Diagram 6) is the same stuff that they can see growing on the bread, except that the picture has made the mould seem much bigger.

Page 22 The Animal Branch

If you or the pupils have collected some animal bones, and the snail, beetle shells or zongororo rings pass them around the class. Point out that when the invertebrate died and the soft parts disappeared, the skeleton, having been on the outside, still looks similar to the animal.

However when a vertebrate dies, and only the bones are left, it is quite difficult to recognise the original animal.

Pages 24 - 27. Please read these pages with the pupils and make sure that they understand them well.

When they have studied diagram 7 and feel happy about it, you could play the "poster game" with them.

How to make the best use of the posters in a class exercise.

THE POSTER GAME

The Vertebrate and Invertebrate posters have some good pictures, but many of the words (i.e. Chordates) are too advanced at this stage. We suggest you cut out each of the animals separately and use them for a class sorting out exercise. Make it a fun game!

P

You will need : the 2 posters
scissors
paper
pen
pins or paste (if possible)

(A simple paste can be made by mixing 1 measure of flour and 1 measure of cold water).

Cut out the animals and also the headings - Vertebrates, Invertebrates, Fish, Amphibia, Reptiles, Birds and Mammals.

DO NOT include the worm like fish on the extreme left of the poster on Vertebrates as they will not be recognised as vertebrates by the pupils.

Mix up the pictures in one pile.

Tell the pupils that you have a mixed pile of animals and they are going to decide which group they belong to, the Invertebrates which you will put on your left, or the Vertebrates, which you will put on your right.

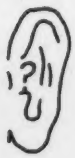
Hold up each animal picture in turn. Ask the pupils to name the animal if they can and decide where it fits.
Next take the Invertebrate pile away.

Put out the 5 headings: Fish, Amphibia, Reptiles, Birds and Mammals on your desk.

Pick up each Vertebrate picture in turn and ask the pupils to decide which of the 5 tribes it belongs to.

When the animals are all sorted out, they and the headings could be pinned or pasted onto the sheets of paper and stuck up around the classroom.

Page 28 Please read this with the pupils because the develop-ment of the key is very important.
Many of the following pages are for the pupils to read. You could get them to do this reading aloud in turn or reading quietly to themselves.



Pages 29 - 31 The Invertebrate Key

You will need to read the key to them while they look at the pictures of the animals.

Next show them how the key works by using it with the description given of the first animal as below.

Animals 2, 3 and 4 can then be identified by the pupils themselves.

1. Ask the class about the first division characteristic which is "with or without a shell".
   The clue is in the description where it says "it feels hard". Thus it belongs to the group "animal with a shell".
2. The next characteristic for division is"whether the animal has legs or is without legs". The description says it has many legs. This places it in the group "Animals with legs". It is not a snail!
3. The next division is "does it have 6 legs?" No it has many legs. It is long and thin and has many legs so it is not a beetle. It is a zongororo.

23

The second animal is for the pupils to do on their own. (Experiment 9). The following hints on divisions are given for marking :

1. First characteristic division - It is an animal without a shell.
2. Second characteristic division - It has no legs.
3. Third characteristic division - It is not long and thin and rope like. It is a slug.

The third animal.

1. First characteristic division is - It is an animal with a shell as it is hard.
2. Second characteristic division - It has legs.
3. Third characteristic division - It has 6 legs. It is not a zongororo.
4. Fourth division characteristic - It is black, not striped, so it is a Rhino beetle.

The fourth animal

1. The first characteristic division - It is soft and slimy, so has no shell.
2. The second characteristic division - It has no legs.
3. The third characteristic division - Long and thin. It is an earthworm.

Page 32

N.B.

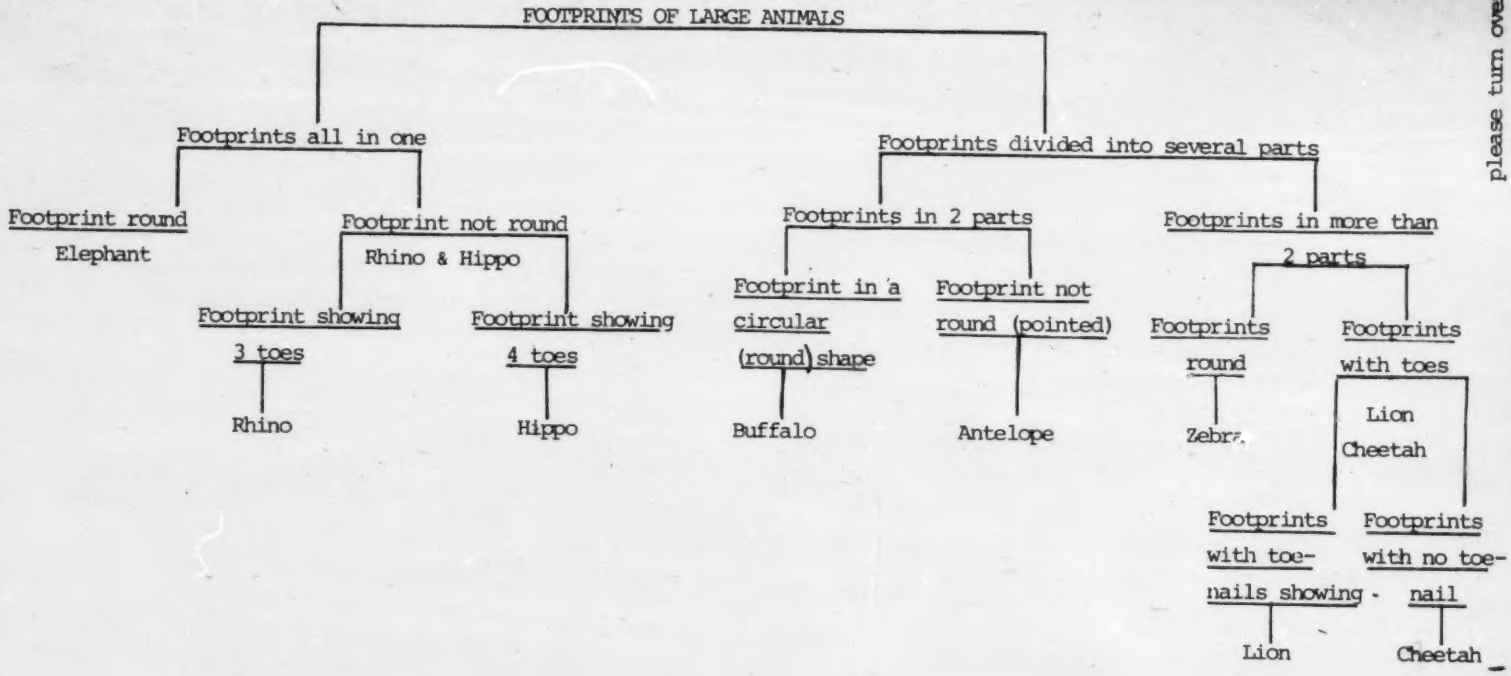
Please note this is not Exercise 10. It should be called Exercise on making a key.

It will be interesting to see how the pupils tackle the problem of making a key. It is a difficult one for this age group. However, this key can only be made on the characteristic of shape as size, etc. are not incorporated. It is expected that the first grouping will be thus :-

Characteristic - footprint whole or divided into parts.

Group I. Footprint all in one Rhino, Elephant, Hippo

Group II. Footprint in several parts Antelope, Buffalo, Zebra, Lion Cheetah



please turn over

30 A key of animal footprints

Put up this chart on the board for the pupils to copy.

Further division of Group I

The elephant has a round footprint while the other two do not. So this will form the first characteristic difference. To separate the rhino and the hippo prints, one may see that the rhino has 3 toes and the hippo 4. Thus number of toes is the characteristic for division here.

Further division of Group II

The antelope and buffalo prints each have 2 parts. The other three have more than two. So number of parts would be the first characteristic difference. To separate the antelope and the buffalo prints is easy because the shapes are different. One is pointed and one is round. The last three prints needing separation are the lion, cheetah and zebra. The shapes once again are different because the zebra print is round, whereas the other two have many toes. You could also consider that the zebra print has 4 parts while the others have more than 4.

Lastly we are left with the lion and cheetah. As you can see, the lion print has toenails while the cheetah print does not.

To summarise all this, the key is shown. Follow it through for yourself as you read the above again.

There are, of course, other possible groupings and some of the pupils may produce keys which are different, but still acceptable.

You can explain how you do the key and put it up on the board for those pupils who were unable to make a key for themselves.

Page 33 How much do they know?

The answers to this exercise are :

1.
2. random
3. plants
4. vertebrates
5. invertebrates
6. six
7. living thing
8. scales
9. reptiles
10. hard
11. soft, water
12. sorting out animals (or similar answer - use your judgment here)
13. suitable answers are :
    - they are born
    - they die
    - they can move
    - they need water/food

    Again use your judgment!

Page 34 - 38 The earthworm

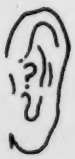
It would be an advantage if you could find a source of earthworms so that each child could have one. Try looking by digging in a vegetable garden or in the damp soil near a river.

However the school has been sent 5 in a jar containing dark soil mixed with mealie meal to keep them alive for several weeks.

You will have to remove them most carefully with a spatula or stirring rod, so as not to break them in half. Do this the day before the lesson on worms as it takes a long time. Remove all the soil a little at a time and transfer it and the worms into a plastic bag for convenience. Wash the jar.

For the next lessons (pages 36 - 37) you should have ready :

Your packet of earthworms in the dark soil
5 plastic bags on which to distribute the worms
1 plastic bath
hand lenses (1 per pair of pupils)

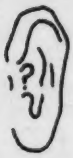


First divide the class into 5, giving each group at least one worm. Tell them to watch how it moves first, then pick it up, feel it and examine it with their hand lenses. Impress upon them the need to handle the worms gently or they will kill them!

After they have looked at the worms for a while, conduct a class discussion on their observations. They should be able to note for themselves the colour, damp feel, length and the lines on the surface, but you may need to draw their attention to the following :

1. An earthworm has a head end. This has a small paler projection which goes in and out as the worm "seems" to be feeling its way. The tail end is less pointed.
2. There is a saddle which is like a band around it. Often nearer the head than the tail. This makes a case to protect earthworm eggs when they are laid.
3. The worm is divided into segments - the parts between the lines which may be seen going around the body.
4. The under surface is a slightly different colour to the upper surface. The pupils can feel a certain roughness

if they run their fingers gently up and down the under-surface of the worm. This is caused by tiny bristles which stick out from the segments and are used to grip the soil as the worm moves. The pupils may or may not be able to see these, but ask them to try, using the hand lens. If they put the worm on a piece of paper on top of their boiling tin and all keep VERY quiet, they may hear the faint scratching noise the worm makes as it moves across the paper.



5. The worm moves by stretching one part out forwards then it grips that part into the soil while it pulls up the back part. This can be observed by watching the segment lines on the body. They are further apart when the worm is stretching and nearer together when the body is being pulled up as in the diagram.
   The worm can move backwards as well as forwards if it needs to, by the same method.

6. The worm is sensitive to touch - it reacts by wriggling wildly when it is touched anywhere.

Exploring tip at head end of worm

Blunt tail end

A. The front and back ends with the segments squeezed up together.

B. The front half stretches forward (the segment lines are further apart).

C. The front end squeezes up stretching out the back end. The worm has moved forward.

Page 37 Experiment 8

The pupils should do Experiment 8 to find out where an earthworm likes to live. Provide the plastic bath, but let them go outside to look for the soil, leaves and stones.

You should draw on the board the diagram (previous page) of the head,tail and movement. They can write the description as an assignment.

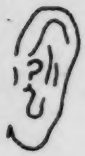
After a day or two let the pupils open up each heap in the plastic bath to find where the worms are.

They may find them in the damp leaves or in the damp soil.

This should lead to the conclusion that worms like a dark damp place to live in.

If they are found in the dry stones/leaves/soil etc. they will be in a poor condition or dead and this factor could be pointed out. A dry place is not suitable for earthworms.

Page 38 Making a wormery



You can now make the wormery. For this you will need :
the clean jam jar
the dark soil
the packet of white sand
a spoon or spatula
the worms
the bottle lid
pieces of fresh plant material etc. as suggested in Study Guide (Exercise 9) page 38.

To make a wormery in the glass jar

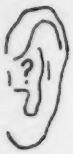
You will have some white sand, and the dark soil which was in the jar with the worms. Make layers in the jar. First put in some dark soil, press it down gently to level it off. Then put in some light soil. Level this carefully. Try to end up with at least 5 layers as in the diagram. If the soil is dry, a little water can be added to each layer. Explain to the pupils that the soil must not be too wet, or the worms will drown. They will need some air in the spaces between the grains of sand. Tell them that the soil layers are not necessary to the worm, but will show where the worms have been if the soil gets pushed about. Put the worms on top of the jar. They will quickly burrow in. Show this to the pupils.

Page 38 Experiment 9

To find out what worms eat

Place some samples of dead plant material, live plant material, a piece of meat or a dead insect, a small stone and a piece of stick on the top of the jar. Replace the lid and tie some paper around the jar to keep it dark.
After a week remove the paper and allow them to see how the soil has been moved around. Explain that earthworms plough the soil, and pull dead plants into their holes. These holes may be seen on the top surface and you may also note that the vegetable matter has been pulled into these holes. Small piles of soil may be seen next to the holes on the surface.

Discuss these points with pupils :-



Why did you provide all sorts of heaps of material for the worms? You did so in order to find what sort of place a worm likes best to live in. If you had only given it a pile of stones - it may have crawled into it and you would have thought - "Ah, a worm lives among small stones".
Why did you give it several choices of food? If you have only given it a shred of wood, it may eventually have eaten it, if it were starving - but that would not have told you the truth about what a worm normally eats!

Now give the pupils Exercise 10 to do.

Exercise 10

Some questions on the Earthworm.

1) In what sort of place does an earthworm like to live?
2) What sort of things do earthworms like to eat?
3) What do earthworms do to the soil and how are they useful to man?

N.B.

If you have time there are notes on keeping other animals at the end of this teacher's guide

Answers to Exercise 10

1 It likes cool damp conditions which is why it comes up to the surface of the soil at night to feed and not in the hot dry day time.

2 It eats vegetable matter, not meat. This vegetable matter is pulled down into the burrow of the worm. The worm thus ploughs the soil by letting air in, pulling dead plants in and bringing subsoil to the surface.

(Some earthworms in Australia grow up to 3 metres long)

3 Earthworms are helpful to farmers as they plough the soil, opening it up to the air and enrich it by pulling dead plants into the soil (like making compost). This means the soil becomes more fertile and grows better crops.

Page 39 Some grass, water & soil in a bottle

P

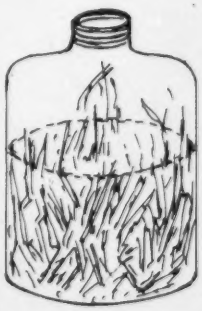
You are asked to make a straw infusion for the pupils to do experiment 10 (page 39) which is "Looking at very small life".

This straw infusion needs 2 weeks to mature before small animals can be seen so you should make this as soon as possible.

You will need : 1 clean bottle
some soil
water
several handfuls of broken up dry grass.

Place about 1 cm of soil on the bottom of the bottle. Add several handfuls of grass (there should be plenty of this). Now half fill the bottle with water. Allow to stand in a cool place. Do not leave in the sunlight.

After two weeks the bottle will be ready.



Keep the straw infusion until Unit A2 is complete.

Tell the pupils only that you are making a small pond - with water and mud at the bottom and the grass represents the dead plant material from the plants around the pond. It is similar to the pools they might find in the bush during the rainy season.

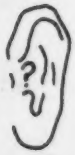
Later you can explain why it is not safe to drink pond water.

N. B.

Please read Pages 32 to 34 in this teacher's guide BEFORE you begin the lesson on the microscope, because the organisation of this lesson is very important.

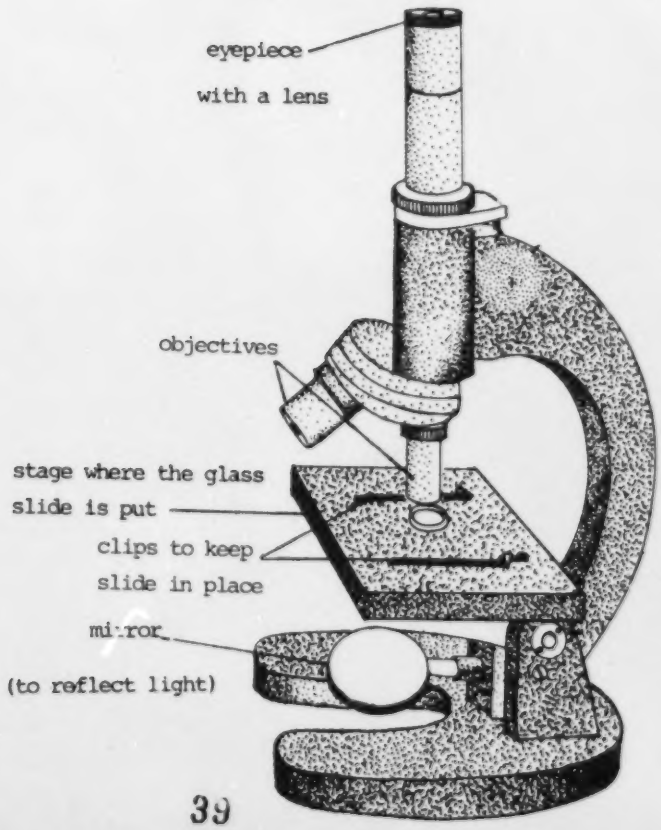
The Microscope

This is a very delicate magnifying instrument. Pupils should use it ONLY with your supervision. Please look at the diagram below and study your microscope.



You will see three objectives of different magnifying strengths. These may be rotated. Start by using the X4 objective and focus by turning the screw. You can increase to X10 or X20 as desired. The eyepiece will convert these magnifications to X40, X100 and X200.

THE MICROSCOPE



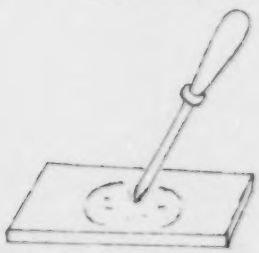
Observations on small animals living in bottle

You will need : pins
cotton wool
slide
coverslide
bottle containing straw infusion

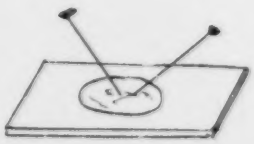
Using a dropper, take some water from the bottom of the bottle and put a drop onto the slide. Put one or two threads of cotton wool into the drop
Using 2 pins pull the cotton wool out evenly within the drop of water. (The cotton is to trap fast moving organisms)

Lower a tiny glass cover slide gently over the water. An easy way to do this is to hold one edge of the coverslide at the edge of the drop of water, with your left hand. Using your right hand hold the other edge up with a pin. Remove your left hand and gently lower the coverslide on top of the drop.

Diagram of how to make a slide

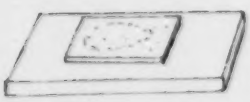


Put a drop of water on the slide



Place a few shreds of cotton wool in the drop and pull them out.

Place edge of small square glass coverslide in the edge of the drop. Hold the other edge up with a pin.



Lower the pin gently until the coverslide lies on the drop of water.

To view the slide

Looking down the eyepiece of the microscope adjust the mirror to reflect enough light. Put the slide on the stage and focus until you can see the threads of cotton wool.

You should see very small round objects moving around. Focus until they are clear. They will probably be moving rather fast. By moving the slide around you may be able to find a few trapped among some strands of cotton.

Try some more drops this way. Some may have very few small animals, some may have a good number, and you will know which is the best one to use when you demonstrate to the class later. Wash your hands!

Here are some small organisms you may see in the drop of water.

Page 41 (Life in a pond)

Have the Bioviewers and slide strips ready to give out after pupils have finished looking through their lenses. They can read about the Bioviewer and look at slide strips (page 42) while they are waiting to see the microscope.

To demonstrate very small life to the class

Distribute 1 slide, 1 lens, 1 Bioviewer and slide strip (in envelope) per 2 pupils. Give each pair of pupils a drop of water on their slide.

Demonstrate to the class the microscope and how it is used using one of the slides you made before.

Call up a few pupils at a time to view the microscope. You should supervise this. The rest of the pupils can be busy working with their Bioviewers.

They should make a drawing of each animal from the slide strip naming it.

Insist on the pupils washing their hands after making slides with the minipond water. They should use soap and water. The things which live in stagnant water can make them sick. Ask the class if the animals they see are vertebrates or invertebrates. (They are of course invertebrates).

Page 43 To see if plants move

Do this at the beginning of the unit : that is a few weeks ahead of time.

You will need : 10 bean seeds
5 plastic bags
soil and water

Half fill the plastic bag with soil. Make 2 holes in the bottom of each with the point of a pencil. In front of the class plant 2 bean seeds in each packet, just under the surface of the soil. Water well. Tell the pupils that you are preparing for a later experiment.
Keep them watered in a safe warm place such as a windowsill. Look at them every few days. The point at which you actually demonstrate to the class how a plant moves will depend on the climate! If the weather is warm you may do it in the middle of the unit and if it is cold the beans will take longer to germinate and you will only be able to do it at the end of the unit. It is a good idea to keep the plants where the pupils can see them as they germinate and push throug the soil.
When 2 real leaves are showing, you may prepare again for the lesson.

The lesson on how a plant moves (page 43)

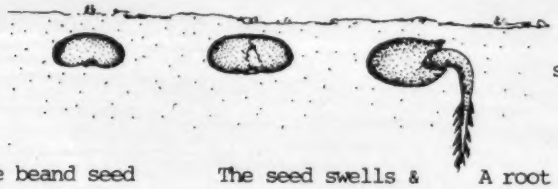
Soak 20 bean seeds for 48 hours in water in a suitable container.

You will need : 20 soaked bean seeds
the growing seedlings

Give out one soaked bean per pair of pupils on their evaporating tins. Tell them to look at the skin, then to break open the seeds. Point out that the seed is in 2 halves.
Point to the bean plants, reminding them that they saw you plant similar seeds and have been watching them.
Explain that these 2 halves of the seed have become "seed leaves". Remove one plant from the soil to show that there is no "seed" below ground and point out the fleshy "seed leaves" on the plants.

Pass round the growing plants and the one plant which you took out of the soil so that it may be seen that the 2 halves of the bean seed are now the seed leaves.

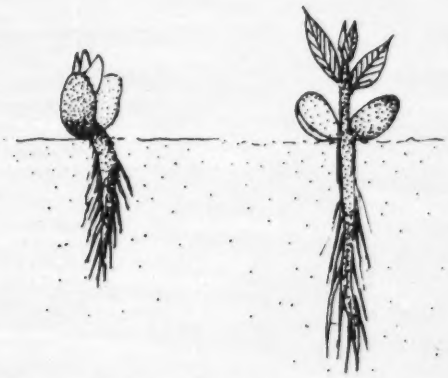
Tell the pupils that the root has pushed the old seed out of the ground where it was originally planted. Therefore it can been seen that a plant can move.
Give the pupils the following diagrams on the blackboard and ask them to copy them into their exercise books to show that a plant can move.



The beand seed

The seed swells & the brown skin bursts

A root grows out



The seed is lifted from the soil. The 2 halves open & some leaves start growing.

Now take half the remaining plants and place back on the window-sill. The other half place in a dark cupboard for use in Unit B. Remember to keep watering them!

Page 43 Experiment 12 Planting a tree

This exercise is of economic importance to the country, so it is hoped you will generate a great enthusiasm among the pupils for it.

Exercise 12

Hints for marking.

1) They provide shade and shelter from the wind.
2) They provide fuel for fires.
3) They provide material for building houses and fences.
4) They keep the soil from blowing away and protect the land.

Discuss with the school staff or parents a prospective planting area. Read the instructions right through so that you can advise them on the choice. It could be unused space near the shool or an area near the village.

1. Look at the key and decide which of the 3 types of seed to use.
2. Give the pupils each a plastic bag. Tell them to fill the bag with a mixture of top soil and compost or vegetable matter from the bush and bring them back to school. They can put them all in a safe place such as under a tree where playing children and animals such as goats will not cause damage.

3. They should poke two or three holes in the bottom of the bag for drainage, then water them. Explain that - like they did with the earthworm, they are preparing the right place for the seedling to live and grow and that soil and compost must have time to settle and mature.
4. Appoint 2 responsible pupils who should each act for a month and check that the packets are watered once a week.
5. On the first day of the September term an official seed sowing ceremony could be held. The pupils must plant their own seed according to the instructions given by you and maintain the plants from then on. You should keep an eye open to see that they weed and thin out and water when necessary.
6. Try and arrange for someone to water once a week in the December holidays if the rains are bad.
7. Next year an official tree planting ceremony could be arranged at the beginning of the rainy season.

GUM TREE SEED

Seeds are sent to you of the following varieties :

1. Eucalyptus Grandis
2. Eucalyptus Tereticornis
3. Eucalyptus Camaldulensis.

Key for choosing seeds No. 1

1. Plant No. 1 (Eucalyptus Grandis) if your area has a heavy rainfall and good soil.
2. Plant No. 2 (Eucalyptus Tereticornis) if your area has fair rainfall and warm climate.
3. Plant No. 3 (Eucalyptus Camaldulensis) if your area is hot and dry.

When in doubt - plant No. 3 as it will survive most conditions.

Seed Sowing - plant seeds at the beginning of the Third Term - mid-August to mid-September.

Germination is 4 - 14 days after sowing.

INSTRUCTIONS TO GIVE THE PUPILS ON PLANTING & GROWING GUM TREE SEED

How to raise seedlings :

a) Fill containers with a mixture of top soil and compost, to about 1 cm from top;
b) Make a small hollow about 3 mm deep, in the soil, in the middle of the container;
c) Put a few seeds into the hollow and cover with soil;
d) Keep the containers moist throughout all stages;
e) Keep the containers under a light shade;
f) Remove weeds at the edge of the containers;
g) When seedlings germinate several will come up in each container. When they are about 2,5 cm in height, remove all but the two tallest and strongest;
h) When these two are about 5 cm in height, remove the less strong one. Leave the single seedling to grow until ready to plant out at about 10 cm in height.
i) If there are any containers in which nothing has grown, spare seedlings can be planted in them.

You can ask for advice from your nearest Forest Officer, Conex or Devag Officer.

Choice of tree site

It is exciting to plant trees for your village or a tree for your garden, but it also takes a great deal of thought, because the tree you choose will become your friend and companion for many years to come.

Sometimes, because of lack of knowledge, the choice of site for your tree is not always wise, with the result that, as the years pass by, the little seedling planted with so much care, grows so big that it either throws too much shade over the house or cuts out the light from a room and eventually has to be cut down.

Gum trees grow very large, so do not plant close to buildings.

Preparation for Planting

Preparation of the planting hole is of great importance because that is what will determine the rate of growth, health, vigour and the shape of the tree in years to come. This should be done during the third term of the following year.

You should therefore dig holes at least :-

1 m (1 pace) x 1 m (1 pace) x 1 m (1 pace) deep and at least 3 m (3 paces) apart.

When digging holes, keep the top soil and the sub-soil separated.

Once the hole has been dug, use a pick or a badza to break up the soil at the bottom. If drainage is poor, place a layer of rubble in the bottom of the hole. It is better to prepare the holes months in advance and into these holes throw all the kitchen scraps and garden sweepings. If this is not possible, near the planting time dig the holes and mix the sub-soil with a little compost, and if you have it, a handful or two of superphosphate. Put this mixture into the hole. To the top soil add some well-rotted compost and some superphosphate. With the added rubble, kitchen scraps and compost, not all of the soil removed from the hole will go back into it, so there will be a mound formed.

Plant the tree on this mound. You will find that the ground will settle down again.

REMEMBER to remove the plant from the container - whether it is a tin or plastic bag - before planting, because if you do not, growth will be stunted.

Care of Trees

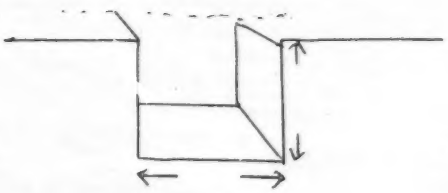
Plant the trees after the rains have started i.e. at the end of the 3rd term.

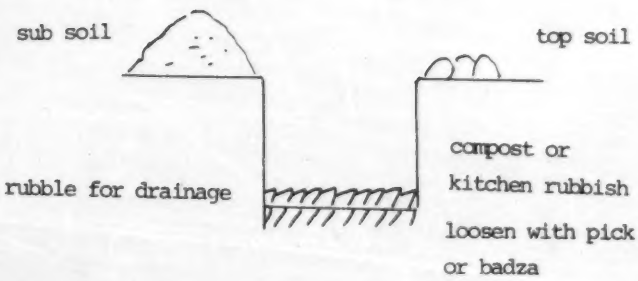
Care must be taken after planting to shade the trees from the hot sun or frost as necessary. They will need water, they will need to be weeded (trees and grass do not get on well together) and the soil around the plant should be kept loose.

Dead grass placed over the loose soil will help keep the soil damp.

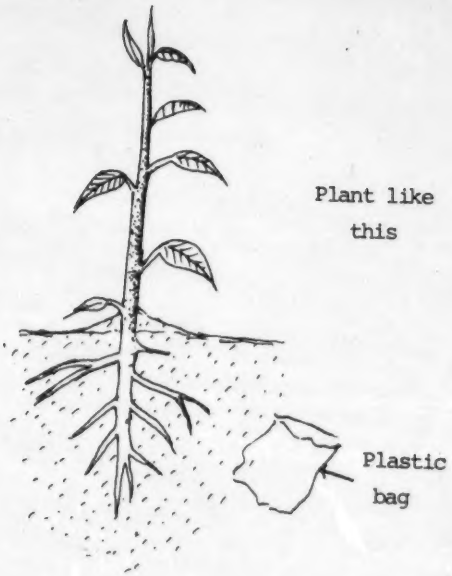
Young trees must be protected against damage by placing a circle of stones around them - about 1 m (1 pace) from the tree or a circle of crossed sticks (XXXXX) around each one.

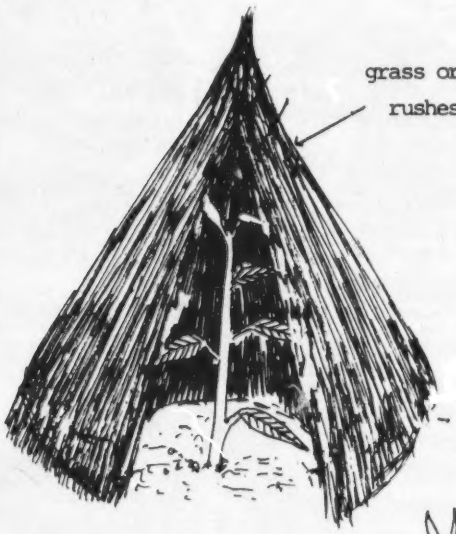
Preparing for planting



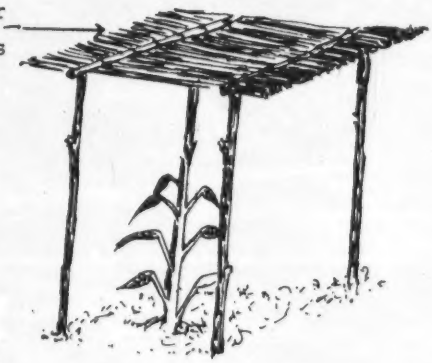


Big holes like this at least 3 paces apart

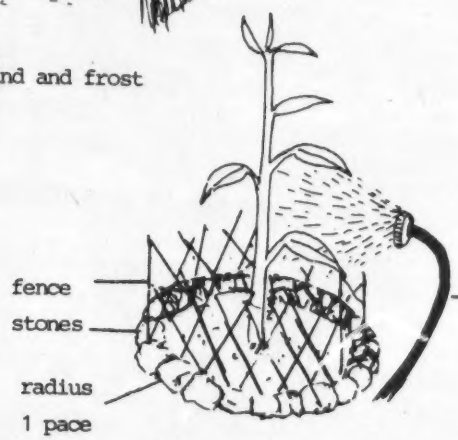




shelter from wind and frost



shelter from hot sun



Page 44 How much do you know?

Answers for marking :

1. Making things look bigger
2. A cool damp place
   Plant matter
3. Hairs
4. Handlens/microscope
5. (As answers to Exercise 12)

Page 45 Summary

Please read this aloud with the pupils very carefully. The pupils could copy this summary into their exercise books.

When they have finished the unit, ask the pupils to look back at Page 1 of their study guides. They can now read through "Aims" of the unit and will find that they can understand them all! If there is any "aim" that they feel is not fully understood please go over that section again.

N.B.

If you have any comments on this unit, please write and let us know what they are.

We look forward to hearing from you. We hope you enjoyed teaching this unit.

ZIM-SCI TEAM

ADDITIONAL NOTES

Keeping other animals in the class.

When there is time it is a good idea to study animals other than the earthworm. Grasshoppers, locusts, caterpillars or woodlice are easy to look after in the classroom. Most insects are difficult to obtain in winter. However, one which can sometimes be found is the woodlouse. This is one of few crustaceans which live on land,(most live in water) and it needs a cool damp living space. If you look under stones, or in compost heaps, or under the loose bark of trees you should find some. They are grey in colour and have many segments. They can move fast, so you have to be quick to catch them. They can be kept until needed in the insect bottle with some soil at the bottom and bark, damp leaves and small stones placed on the soil in a cool place.

In the first lesson put them in conical flasks and pass round the class.

Pupils can examine them with a hand lens and note features such as

1. number of legs
2. number of segments
3. how they move
4. colour
5. presence of eyes

and write a description. You may give them a drawing to copy.

You may take the pupils outside to find their own specimens. Show them the sort of place to look. If they find their own it will help them to decide what materials to put in the baby bath.

They can then find out what sort of conditions a woodlouse likes to live in in the same way they did with the earthworm. Supply the baby bath.

Notes to give the pupils

The woodlouse has biting mouthparts. It dries out easily and needs moist conditions as it keeps cool by the evaporation of water over its surface. It will seek dark places and run away from a bright light. It may run away or roll up in a ball if touched.

These characteristics may help you to decide on a choice of experiments for the class to do with the woodlice.

Keeping grasshoppers or locusts

Pupils should be able (in the warm weather) to find a few specimens themselves. They should collect them in plastic bags with airholes and make notes of the conditions under which the insects were living when collected, such as
1) what it was eating
2) on what sort of plants it was found.

The specimens can be kept in the insect cage which can be equipped in this way :-
Line the bottom with sand.
Place a container of fresh water in the middle. Keep green plant material with the cut ends in the water. Replace with fresh plant material every 2 or 3 days. Cover with the net. Keep cage in a warm light place.

This simulates the conditions under which it was found.

Pupils can firstly examine the specimen under their hand lens. If the animal is lively it can be examined while in a plastic bag (with air holes).
They should note :-

1. The eyes (which are large)
2. The feelers
3. The different types of legs
4. The wings
5. The way in which the mouthparts chew leaves.

They can write a description including how it moves and you can give them a labelled diagram to copy.

Characteristics

1. They eat fresh vegetable material.
2. They jump, fly and climb up grass.
3. They like warmth and sunlight.
4. They lay eggs in the soil (usually loose damp sand).
5. The jump or fly away when touched.

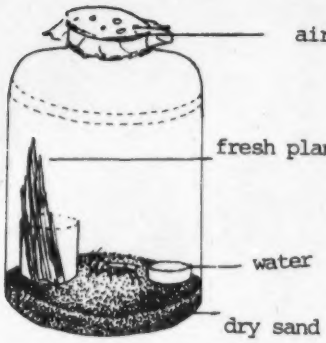
These points may suggest some experiments for the pupils to do.

They are of economic importance as, when they are in large numbers they strip off and eat the green leaves from crops, thus damaging them.

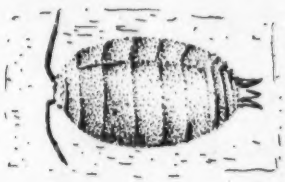
The pupils could keep a lizard in the animal cage.

Supply stones and meat or insects to eat

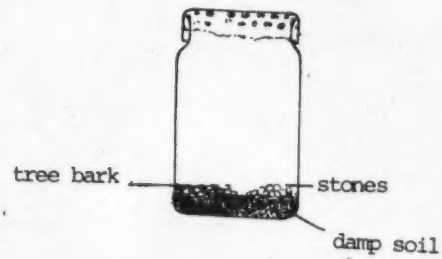
Keep warm.



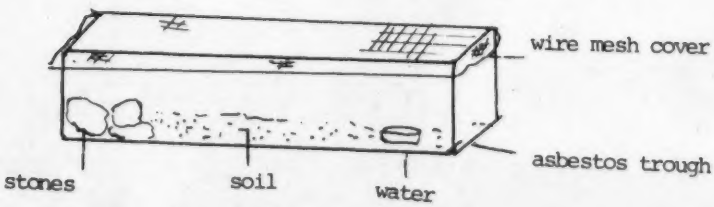
A locust bottle cage



A woodlouse



A woodlouse bottle cage



Cage for lizards, frogs etc.

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